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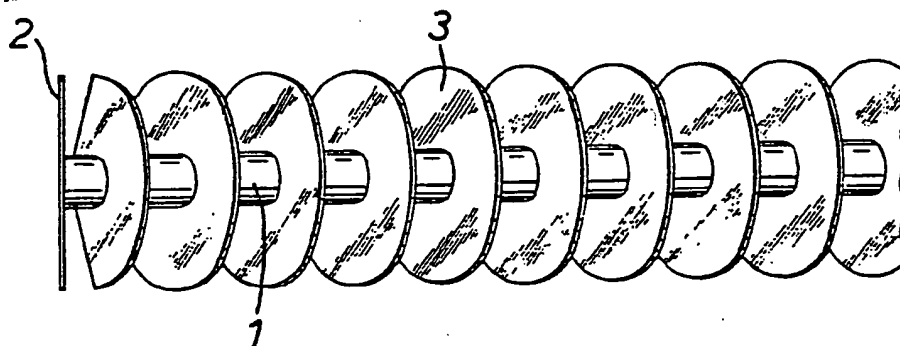
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(54) Title: IMPROVEMENTS RELATING TO ROTARY AGITATORS



(57) Abstract

A rotary agitator is formed by a series of elliptical shaped discs (3) positioned in sequence along a shaft (1) carried by end plates (2) which can be connected to a drive mechanism. The discs (3) are set at an angle other than normal to the axis of the shaft (1) so that the elliptical outer edges of the sequence of discs define a cylindrical shape co-axial with the shaft axis. As the shaft (1) is rotated the discs (3) vary their attitude with respect to the ground but because the discs (3) define a cylindrical envelope the shaft (1) remains at the same height above the ground during rotation. The discs (3) can be used for a variety of purposes such as tilling the soil and sweeping operations.

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"Improvements relating to Rotary Agitators"

This invention is concerned mainly with devices which will be used to operate on surfaces, such as brushing devices or soil tilling devices, the surface being subjected to agitation by the device. Another area where agitation
5 is required is within units for use in distributing fertiliser or for seed drilling, for example.

It is an object of this invention to provide a rotary device which will subject surfaces to a fairly regular and even agitation.

10 According to the invention, from one aspect, there is provided a rotary agitator comprising a rotatable shaft carrying a series of elliptically-shaped discs positioned in sequence along the shaft, the discs each being set at an angle other than normal to the shaft axis so that the
15 elliptical outer edges of the sequence of discs define a cylindrical shape co-axial with the shaft axis.

As the shaft of the agitator rotates, the discs effectively oscillate from one side to the other and the oscillating movement can be used for a variety of purposes, such as soil tilling, cutting, chopping or brushing.

20 However since the elliptical outer edges of the discs define a cylindrical outline they will contact a surface in an even manner so that vibration of the agitator as it



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rotates, in directions normal to the axis of rotation, will be minimal.

In one embodiment each disc may have a central elliptical hole to fit over a central shaft. Alternatively, 5 the shaft could be defined by a series of rods disposed about the axis of rotation and passing through holes in the discs. In this instance the central portion of each disc may, with advantage, be omitted to form a flat annulus or a hoop, which will produce a different type of effect 10 to that achieved by a complete disc.

If desired, toothed portions or tines could be formed at the edges of the discs. These toothed portions or tines may, for example, be formed by projections extending beyond the elliptical outer edges of the discs, 15 or by cut-away portions removed from within the boundary of the elliptical outer edges of the disc. Alternatively, toothed or tined plates may be secured to the outer edges of the discs. It is also possible to provide that pressed parts of the disc project out of the plane of each disc.

20 For rugged usages, such as soil tilling, the discs are ideally formed of metal or other rigid material. For other purposes, however, the outer edges of the discs can be provided with bristles or the discs can be formed from rubber or other flexible material. Additionally, each disc 25 may be provided by a layered structure.

For most purposes it is preferred that all the

discs should be aligned at identical angles to the shaft axis. Another possibility, however, is to provide that the discs are aligned at progressively smaller angles to the shaft axis in directions towards the ends of the shaft.

- 5 Usually it will be preferred that the edges of adjacent discs overlap in planes normal to the shaft axis.

The discs may be mounted on sleeves which are slidably and removably mounted over the shaft, so that they can be interchanged readily. Several discs could
10 be carried by each such sleeve. It is also of advantage for the shaft to be provided with sliding spline-type stub axles so that the whole unit can readily be replaced, reversed or interchanged.

The invention also extends to rotary agitation
15 apparatus comprising a rotary agitator of this invention as hereinbefore defined, and drive means for pulling or pushing the rotary agitator over the ground and/or for driving the shaft of the rotary agitator rotatably.

The drive means could comprise a wheeled drive
20 unit providing bearings within which are mounted the ends of the shaft of the rotary agitator so that the rotary agitator can be caused to roll over the ground, and be driven rotatably solely by virtue of its contact with the ground. Alternatively the shaft of the rotary agitator
5 could be driven by a motor, such as the power take off of a tractor, a hydraulic drive pump, a belt or chain drive,



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or an electric motor.

The apparatus can incorporate two or more rotary agitators whose shafts are mounted in line, with their shaft axes normal to the direction of intended movement of the apparatus. In this instance the drive means could be constructed to rotate the shafts of the rotary agitators at mutually different speeds.

The apparatus may take many forms, such as a land tilling device, a brushing device for surface treatment or carpet sweeping, or a scraping device for surface treatment. Another possibility is for the apparatus to take the form of a fertiliser agitator or seed drilling device, with the shaft of the rotary agitator disposed within a distribution box for fertiliser, seed or the like.

The apparatus may be in the form of a cylinder cutter, with the edges of the discs on the rotary agitator contacting a cutter bar, such as for grass cutting, or in the form of a shaver head with the discs of the rotary agitator contacting a perforated foil head. A still further possibility is for the apparatus to be in the form of a switch gear system wherein each disc of the rotary agitator is associated with a separate switch.

The invention may be performed in various ways and preferred embodiments thereof will now be described with reference to the accompanying drawings, in which:-

Figures 1 to 4 illustrate a rotary agitator

of this invention in four rotational attitudes;

Figure 5 is a plan view of a disc used in the device shown in Figure 1;

Figures 6 and 7 are plan views of additional disc members used in the device shown in Figure 1;

Figures 8 to 14 illustrate alternative shapes and constructions for the discs used in the device shown in Figure 1;

Figure 15 is a side view of the disc shown in Figure 14;

Figure 16 is a side view of a rotary agitation apparatus of this invention;

Figure 17 is a plan view of the apparatus shown in Figure 16;

Figure 18 is a plan view of part of the apparatus of Figures 16 and 17 indicating the manner of rotation of the rotary agitator;

Figures 19 and 20 are views of an alternative form of rotary agitator of this invention in two attitudes;

Figure 21 is a plan view of the disc used in the device of Figures 19 and 20;

Figure 22 is a plan view of another form of rotary agitation apparatus of this invention incorporating a further form of rotary agitator design;

Figure 23 is a front view of a garden cultivator incorporating a rotary agitator of this invention;



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Figure 24 illustrates a modified form for the rotary agitator of the device shown in Figure 23;

Figure 25 is a front view of a vacuum cleaner incorporating a rotary agitator of this invention;

5 Figure 26 is a view of the rotary agitator used in the apparatus of Figure 25;

Figure 27 is a front view of a motorised brushing machine using a rotary agitator of this invention;

10 Figure 28 is a view of a further alternative form of rotary agitator of this invention;

Figure 29 is a plan view of a seed drilling device incorporating a rotary agitator of this invention;

15 Figure 30 is a front view of a motorised cylinder cutter mowing machine incorporating a rotary agitator of this invention;

Figure 31 is a cross-section through a sliding spline stub axle bearing housing for mounting a shaft such as that shown in Figure 1;

20 Figure 32 is an illustration of an agitator roller tool of this invention; and

— Figures 33 and 34 illustrate modified forms and mounting arrangements for discs used in rotary agitators of this invention.

25 The devices of this invention are based generally on the type of rotary agitator bar illustrated in Figures 1 to 4. This comprises a rotatable shaft 1 having mounting plates 2 fixed at either end and carrying a series of discs 3 along the length of the shaft. As can be seen from Figure 5, these discs are of elliptical shape and are provided with elliptical holes which are slid over the shaft 1
30 prior to welding so that the discs are inclined at an angle

to the shaft axis as illustrated clearly in Figure 2. Furthermore, the discs are regularly spaced in such a way that portions of adjacent discs overlap in planes normal to the axis of the mounting plates 2. It will be seen from Figures 1 to 4 that as the shaft 1 is rotated (anti-clockwise as seen from the left hand end) in sequence starting with Figure 1 and leading on to Figure 4, the discs vary their attitude with respect to the ground on which they rest so that the edges of the discs are seen to oscillate from side to side at the point where they contact the ground. However the elliptical outer edges of the discs 3 define a cylindrical outline co-axial with the axis of the shaft 1 so that the shaft always remains at the same height above the ground during rotation. The rotary agitator, as it is rotated, therefore performs side to side oscillation which can be utilised for various purposes but does not oscillate (or vibrate) in the vertical direction so that the device will tend to move smoothly.

At the ends of the shaft 1 adjacent to the mounting plates 2 there will not be room for a complete disc 3 (as can be seen from Figure 2) and so a partial disc 5 (Figure 6) will be formed there.

If the agitator is to be used for tilling the soil it may well be useful to provide teeth or other projections at the outer edges of the discs. Some ways of providing such projections are illustrated in Figures 8 to 15. The



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types of discs shown in Figures 8, 9 and 10 effectively have parts cut away from the basic elliptical outer edge to leave projecting parts which will bite into the ground and create various tilling or processing effects. As
5 illustrated in Figure 12, projections 6 can extend from the outer elliptical edge of the disc. Another possibility is to provide additional picks 7 (Figure 11) or toothed plates 8 (Figure 13) which may be riveted, bolted or otherwise secured to the disc 3. Another type of projection is
10 illustrated in Figures 14 and 15, wherein cutters 9 are formed in the edge portions of the disc which are then pressed out of the plane of the disc, for example as illustrated in Figure 15.

The rotary agitator illustrated in Figures 1 to
15 4 may be incorporated into a cultivator device such as that shown in Figures 16-18. This is provided with upper and lower linkage attachments 10 and 11 for connection onto a tractor and a top linkage support stay 12, to which is mounted a support frame 13 incorporating the rotary agitator 14
20 rotating in bearings 15. A depth wheel 16 is provided at either side of the apparatus mounted on a respective support arm 17 attached to the frame 13 by a pivot 18 and whose height is controlled by an adjustment linkage 19. As shown in Figure 17, the power take off 20 from the tractor drives a
25 shaft 21 which is linked by a chain drive in a housing 22 (Figure 18) to the shaft 1 of the agitator. As the shaft

1 rotates the discs 3 will pass through the two angled conditions 3A, 3B illustrated in dashed outline in Figure 18. Thus the whole width of the area between the ends of the shaft 1 is subjected to action by the discs 3. For a power harrow the discs would be set at a shallow angle of around 20° so that the effective lateral movement of the discs in contact with the ground will be fairly small giving rise to a fairly slight "flicking" effect on the soil. For depth digging the discs 3 would be set at a more acute angle resulting in substantial movement of the soil as the shaft 1 rotates and carries round the discs 3 whilst they are buried in the soil.

An alternative construction of rotary agitator is illustrated in Figures 19 to 21. In this instance the shaft 1 is replaced by four rods 23 mounted in holes in the end plates 2, and passing through holes in discs 24 provided with central openings 25, thus each being in the form of a flat annulus. Again the discs 24 are set at an angle as can be seen from Figure 19 and are welded in position on the rods 23. As this unit is rotated it will act as a crumbler bar scattering and crumbling soil over which it passes. Another form of crumbler bar is illustrated in Figure 22 wherein the discs 26 are more in the form of hoops and are mounted on and fixed to six rods 27 fitted between the end plates 2. Figure 21 illustrates a disc of the type 24 used in the device of Figures 19 and



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20 but provided with six mounting holes 28. The type of disc 26 would have a much larger central hole 25 leaving a narrow ring or hoop through which holes 28 will pass to receive the rods 27.

5 Figure 22 illustrates a soil tiller 29 which has a pair of rotary agitators 30, 31 driven by a hydraulic drive pump 32. If desired the agitators 30 and 31 can be driven at different speeds through suitable gearing so that the front unit 31 rotates at a slower speed than the rear unit
10 30 to give a double digging effect and to apply greater impetus to the lumps broken up by the first unit 31 when they are attacked by the second unit 30. If the two units 30 and 31 are of substantially identical construction and driven at the same speeds then it is of advantage to
15 position the respective sets of discs of the two units so that when viewed from the rear they will appear to overlap in the manner as illustrated in Figure 18. The crumbler bar 33 at the rear helps to break up the surface soil and also acts as a depth wheel.

20 A more simplified form of device is illustrated in Figure 23 and comprises a garden cultivator having a shaft 34 driven from a central gear box 35 and carrying discs 36 which rotate with the shaft 34. Each of the discs is secured on a sleeve 37 which can be fitted onto the shaft
25 34, thus enabling the number or type of discs 36 employed to be varied at will. As can be seen from Figure 24 the

discs 36 could be set at progressively differing angles so that the central discs 36 create greater breaking up of the soil and the outer discs produce more of a feathering effect on adjacent furrows which have been dug previously.

5 Another form of device to which the invention may be applied is a carpet sweeper as illustrated in Figures 25 and 26. A drive unit within the casing 8 drives a shaft 39 by means of a belt received in a groove 40. The shaft carries disc-like brushes 41 of elliptical form
10 set at angles to the shaft 39 as shown clearly in Figure 26. A similar device to that shown in Figure 25 could be used for shampooing carpets.

 The apparatus shown in Figure 27 may be used as a yard or road sweeping device. In this instances the shaft
15 42 driven from a motor 43, carries disc-like brushes 44 of elliptical form set at an angle on the shaft 42.

 With both of the brushing devices shown in Figures 25 and 27, as the shafts 39 and 42 rotates, the edge portions of the brushes in contact with the ground (or carpet) will
20 effectively oscillate from side to side and create an efficient beating, brushing or scrubbing effect.

 Another type of scrubbing device is illustrated in Figure 28 and in this instance a shaft 45 carries
25 respective sets of rubber discs 46 of annular form positioned at angles on the shaft 45. This could be used as a yard scrubber or scraper for scraping dirt, water or slurry



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from a yard surface as the shaft 45 is driven to rotate the discs 46.

Another use for the rotary agitator is illustrated in Figure 29. In this instance a seed or fertiliser drill unit 47 incorporates a driven shaft 48 carrying small elliptical discs 49 set at angles on the shaft 48. As the shaft 48 rotates, the discs 49 agitate the seed or fertiliser within the unit 47 to cause the seed or fertiliser to drop in a reasonably even manner from an outlet aperture in the base of the unit 47.

The rotary agitator could also be used as a cylinder cutter as illustrated in the motorised lawn mower device of Figure 30. The shaft 50 rotates angled elliptical discs 51 against a cutter bar 52 so that grass is subjected to a sideways slicing action as the mower is driven forwardly and this results in efficient cutting of the grass.

Figure 31 illustrates how the shaft 1 of Figure 1 (or the shafts of any of the other devices shown in the drawings) may be mounted in a bearing housing (such as 15 as shown in Figure 16). The end plates 2 will be bolted to a flange 53 via apertures 54. This flange 53 carries a stub axle 55 formed with a spline 56 received within a splined opening 57 in the bearing housing 15. An adjustment screw 58 is provided with a lock nut 59.

Figure 32 illustrates an agitator roller tool

using diagonal, elliptical ring segments 60 that also each incorporate a convex outer rim or ridge either smooth or notched. As required the edge of the segments can be either bevelled or angular. Furthermore the axial centre of each segment has a square or hexagonal sleeve and as required, a number of these cast segments are slid onto the main shaft to complete the roller unit. The tool is drawn at speed over the soil thus agitating and firming it, as these segments do not rotate independently. The tool is raised, for example, by its transporting wheels for tight manoeuvres. Such roller ring segments may be slid onto the garden cultivator of Figure 23, the rotor shaft 34 of which in this instance will be powered. Furthermore the garden cultivator roller may be in the form of a one piece moulded gang unit, which in this case may be moulded in polypropylene or ethylene or some other tough material instead of the usual metal castings.

Polypropylene disc or brush units as shown for example in Figures 27 and 28 may be tractor mounted either forwards or rearwardly, and may also be used laterally or in left or right angular sweeps. Furthermore the rotor may be hydraulically powered in either direction and the tool may also have a twin combination unit with scraper discs to the front and a brush rotor unit at the rear.

The twin rotary agitator unit of Figure 22 may also be a combination tool with say the Figure 10 rotary disc unit



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to the front and the Figure 5 rotary disc unit at the rear, together with a crumbler barrel as shown in Figure 19.

The disc units may be of a knife edge type to quite chunky units. Also the serrations or the like may be varied in number. For example the Figure 8 embodiment could be a four point elliptical star shape.

The apparatus embodying this invention could also be in the form of a processing tool incorporating a raised static or mobile hopper fitted along the base of which is a detachable convexed grid protruding downwards. Within the hopper is a powered twin or multi rotary agitator whose shafts are counter-rotating with the disc units intermeshed (or running between one another) so that the disc units converge into the centre or vice-versa. This processing tool may contain a number of combination rotor units mounted one above the other or being interchangeable for such jobs as shredding baled straw; mixing feed, crumbling baled peat or mincing meat for example, the mulch being spread or collected at the side or beneath the unit.

If the agitator is to be used for tilling the soil or processing feed, etc., it may well be useful to provide teeth, knives or other projections extending sideways from the outer edges of the disc.

Whilst for most purposes it is envisaged that the discs will be flat plates having elliptical shape it is possible to fix or weld on extension portions to basically circular discs, these extensions projecting out of the plane of the disc so as to form a composite disc of S-shape in side view whilst being essentially elliptical in plan view. This arrangement is illustrated in Figure 33 of the drawings wherein flat circular discs 61 carry the curved projecting portions 62.

10 Another possible modification is to provide blades extending generally axially of the shaft between the discs. This is shown in Figure 34 where a set of four blades 63 is positioned between each pair of discs 64 on the shaft. These blades will induce air flow and can
15 thus act as a fan to pass swept up material into a collecting area and would be of particular use with the carpet sweeper shown in Figures 25 and 26 for example. The blades 63 also strengthen the whole unit which can be important for some of the other devices illustrated.

20 Another modification which can be employed is to provide the rotary agitator with a variable drive so that the pounding effect on earth clods, for example, can be varied to suit conditions. If the rotary agitator is subsequently driven in the opposite rotational direction
25 greater soil crumbling will be achieved as a final step.

It should also be noted that any desired



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combination of discs may be employed. For example a single shaft might carry metal discs, rubber rollers and brushes or any two of these so as to operate as a combination tool.

CLAIMS"

1. A rotary agitator comprising a rotatable shaft carrying a series of elliptically-shaped discs positioned in sequence along the shaft, the discs each being set at an angle other than normal to the shaft axis so that the elliptical outer edges of the sequence of discs define a cylindrical shape co-axial with the shaft axis.

2. A rotary agitator according to claim 1, wherein each disc has a central elliptical hole to fit over the central shaft, or the shaft is defined by a series of rods disposed about the axis of rotation and passing through holes in the discs, and preferably the central portion of each disc is omitted to form a flat annulus or a hoop.

3. A rotary agitator according to claim 1 or claim 2 wherein toothed portions or tines are formed at the edges of the discs, such as by projections extending beyond the elliptical outer edges of the discs, or by cutaway portions removed from within the boundary of the elliptical outer edges of the disc, or by toothed or tined plates secured to the outer edges of the discs, or by pressed parts of the disc projecting out of the plane of each disc.

4. A rotary agitator according to any one of claims 1 to 3, wherein the discs are formed of metal or



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other rigid material, or wherein the outer edges of the discs are provided with bristles, or from rubber or other flexible material, and wherein each disc may be provided by a layered structure.

5. A rotary agitator according to any one of
5 claims 1 to 4, wherein all the discs are aligned at identical angles to the shaft axis, or wherein the discs are aligned at progressively smaller angles to the shaft axis in directions towards the ends of the shaft, and preferably, in each case, the edges of adjacent discs
10 overlap in planes normal to the shaft axis.

6. A rotary agitator according to any one of claims 1 to 5, wherein the discs are mounted on sleeves which are slidably and removably mounted over the shaft, each sleeve carrying one or more discs.

15 7. A rotary agitator according to any one of claims 1 to 6, wherein the shaft is provided with sliding spline-type stub axles.

8. Rotary agitation apparatus comprising a rotary agitator according to any one of claims 1 to 7
20 and drive means for pulling or pushing the rotary agitator over the ground and/or for driving the shaft of the rotary agitator rotatably.

9. Apparatus according to claim 8, wherein the drive means comprises a wheeled drive unit providing
25 bearings within which are mounted the ends of the shaft of the rotary agitator so that the rotary agitator can be

caused to roll over the ground, or wherein the drive means comprises a motor for driving the shaft of the rotary agitator, such as the power take off of a tractor, a hydraulic drive pump, a belt drive, or an electric motor.

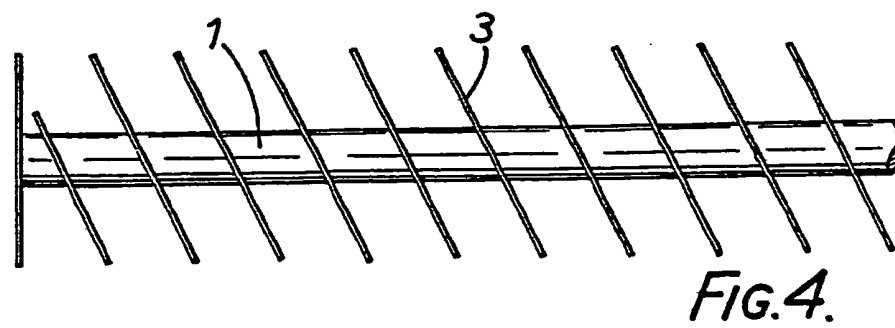
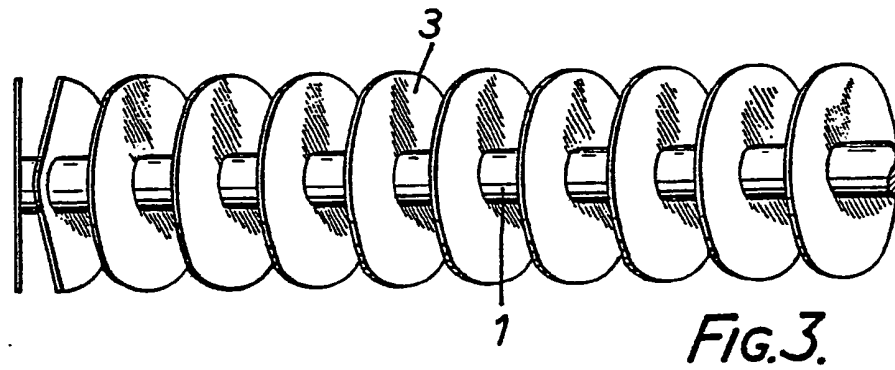
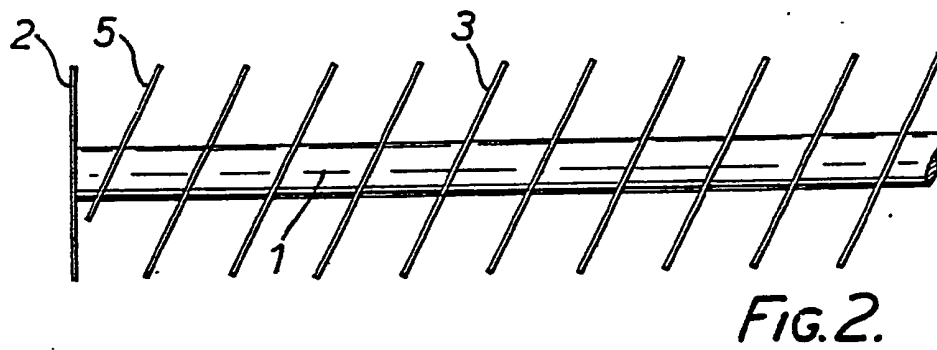
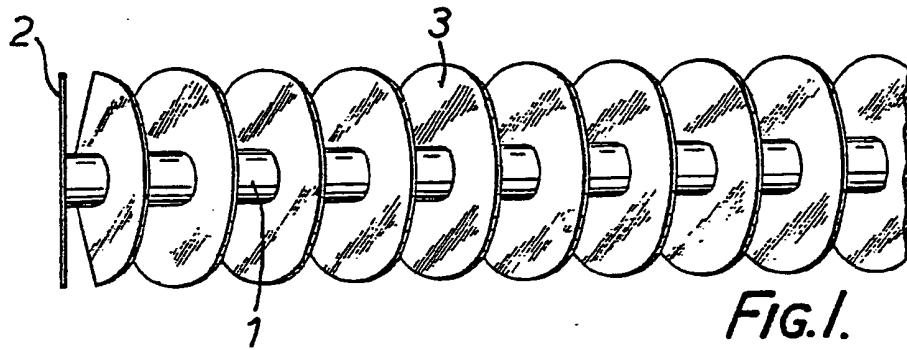
5 10. Rotary agitation apparatus according to any one of claims 1 to 9, incorporating two or more rotary agitators whose shafts are mounted in line, with their shaft axes normal to the direction of intended movement of the apparatus, the drive means being constructed to rotate
10 the shafts of the rotary agitators at the same or at mutually different speeds.

 11. Apparatus according to any one of claims 8 to 10 in the form of a land tilling device, a brushing device for surface treatment or carpet sweeping, a scraping
15 device for surface treatment, a fertiliser agitator or seed drilling device with the shaft of the rotary agitator disposed within a distribution box for fertiliser, seed or the like, a cylinder cutter, with the edges of the discs on the rotary agitator contacting a cutter bar,
20 a shaver head with the discs of the rotary agitator contacting a perforated foil head, or a switch gear system wherein each disc of the rotary agitator is associated with a separate switch.

 12. Apparatus according to any one of claims 1 to 11, wherein axially extending blades are fitted onto
25 the shaft between pairs of discs.



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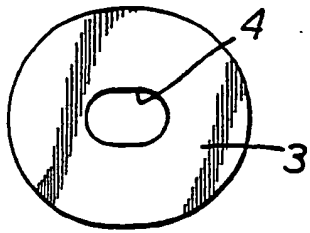


FIG. 5.

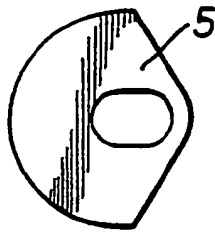


FIG. 6.

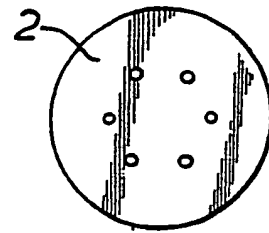


FIG. 7.

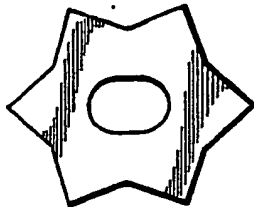


FIG. 8.

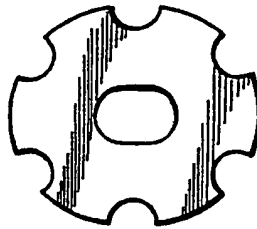


FIG. 9.

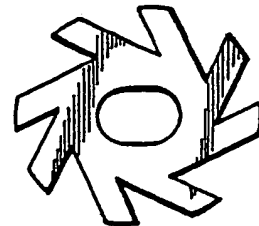


FIG. 10.

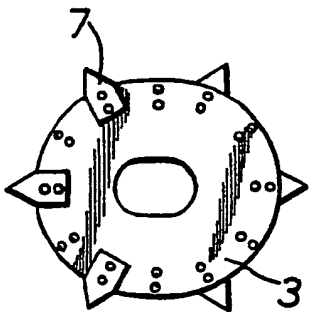


FIG. 11.

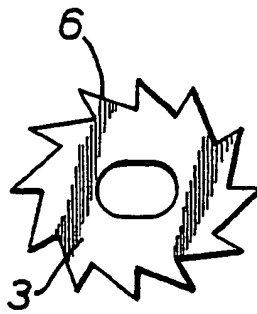


FIG. 12.

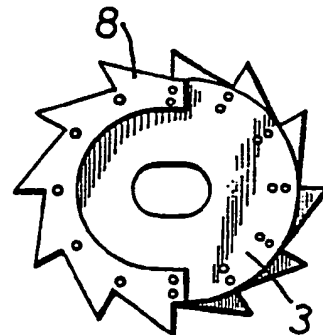


FIG. 13.

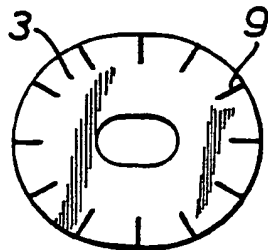


FIG. 14.

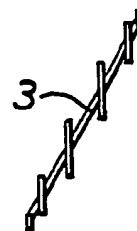


FIG. 15.

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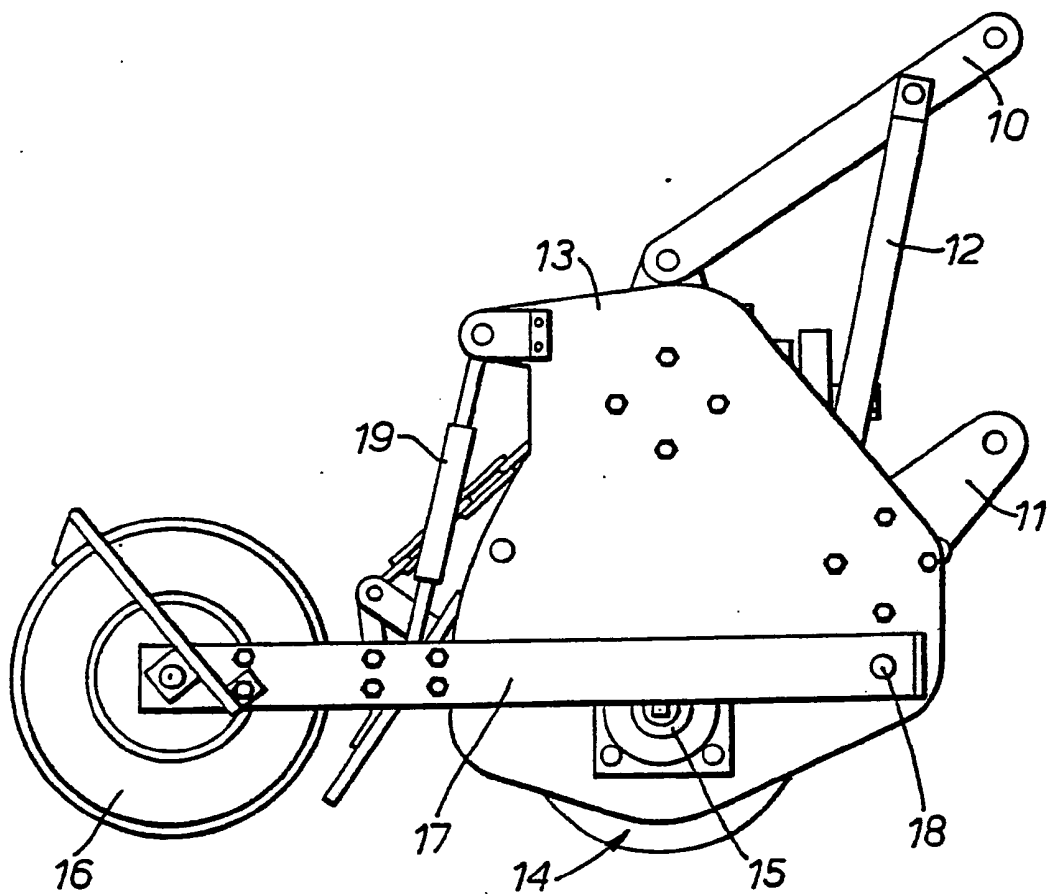


FIG. 16.

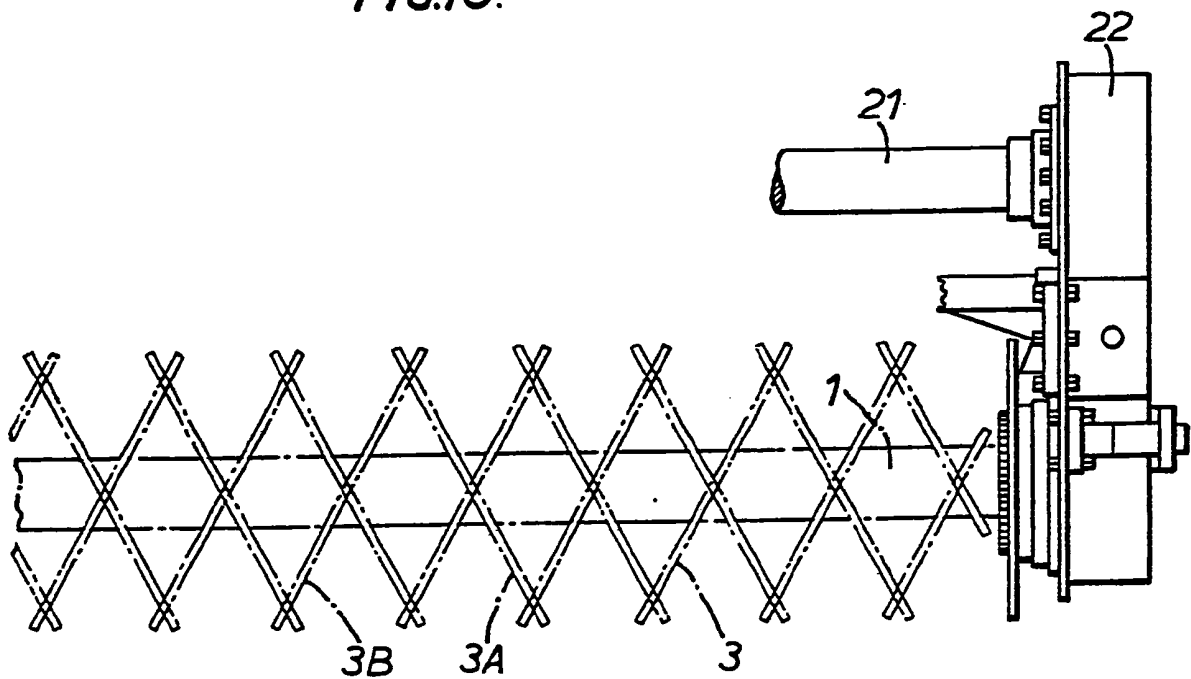
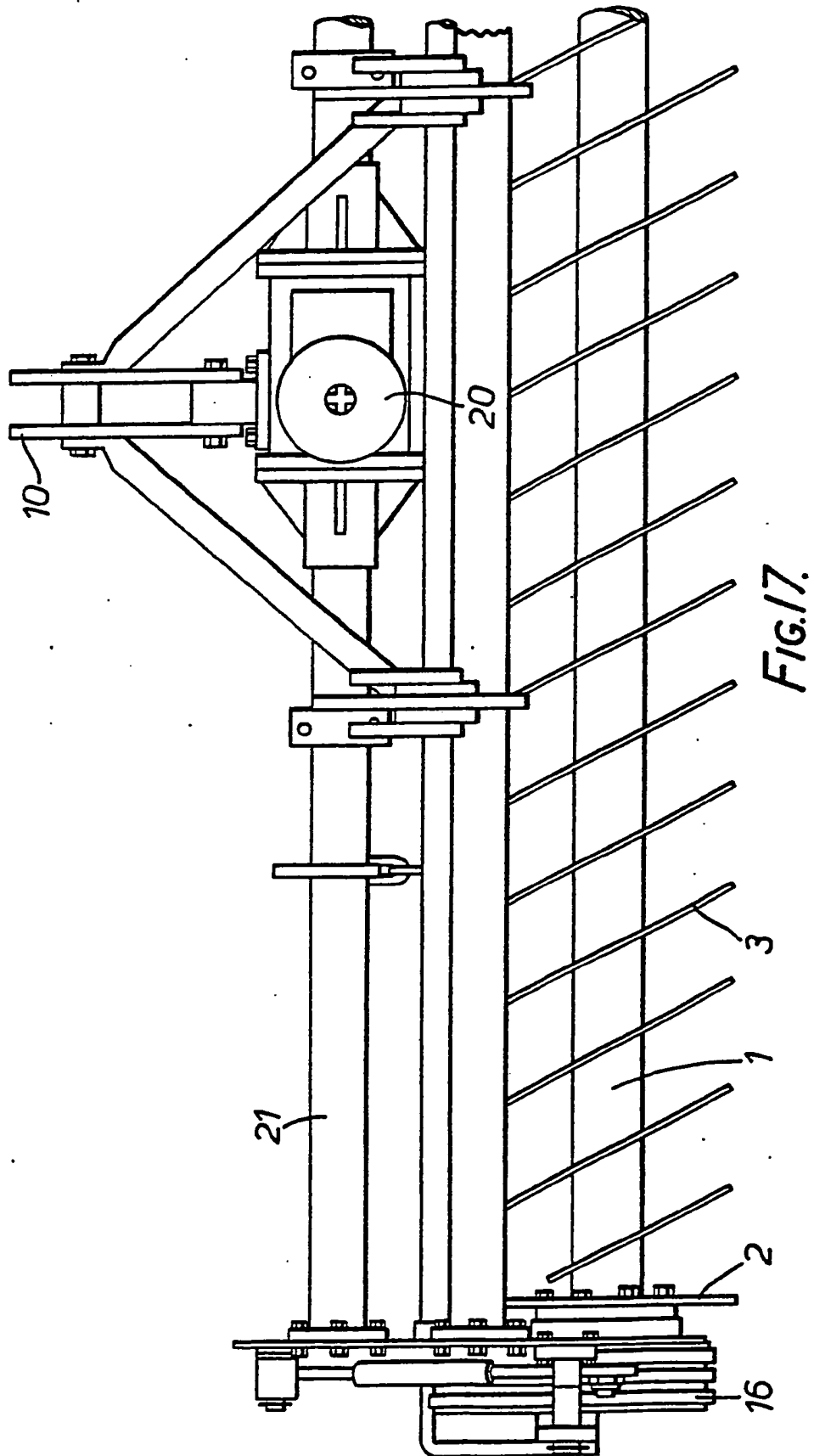
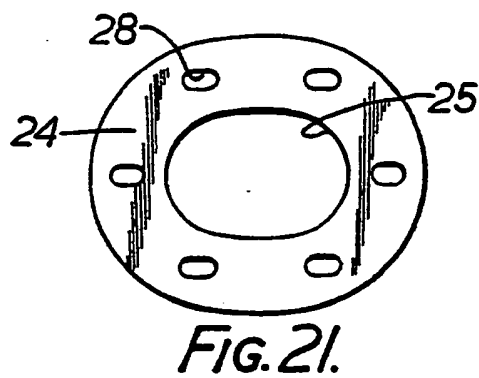
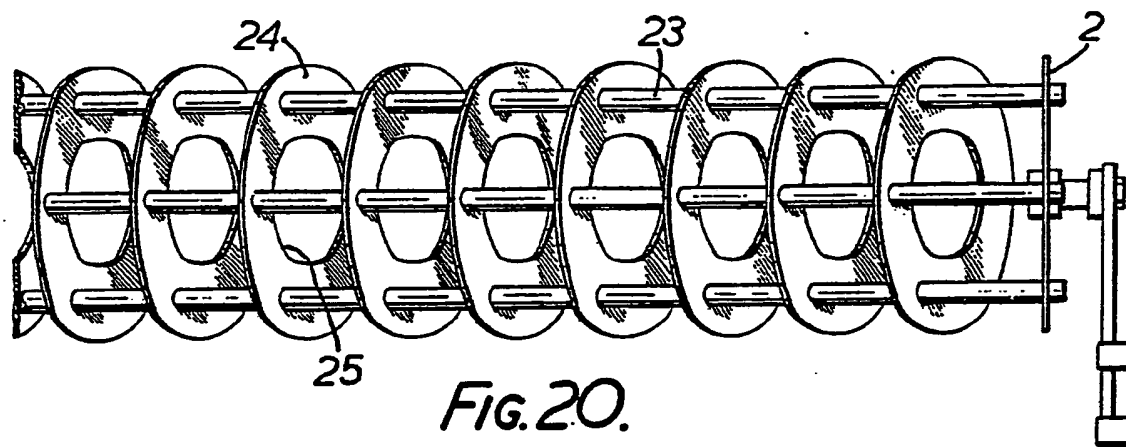
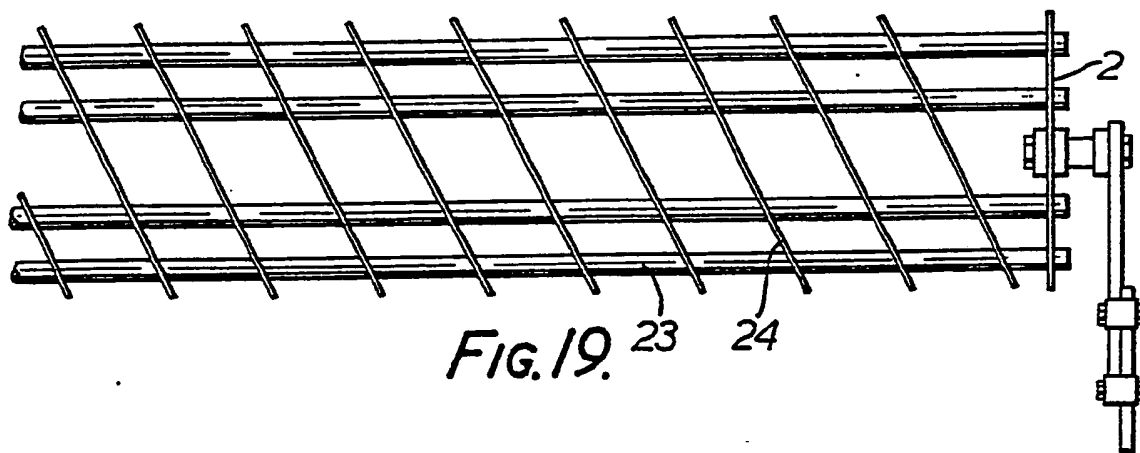
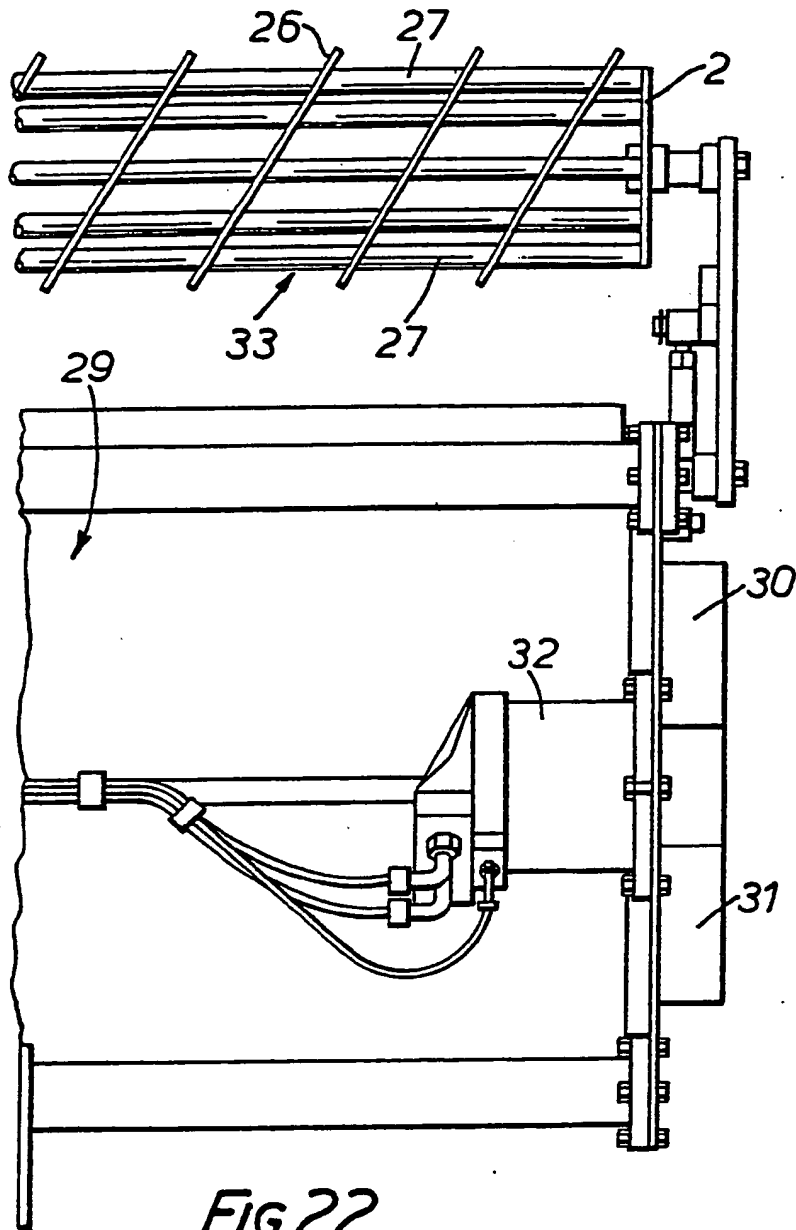


FIG. 18.



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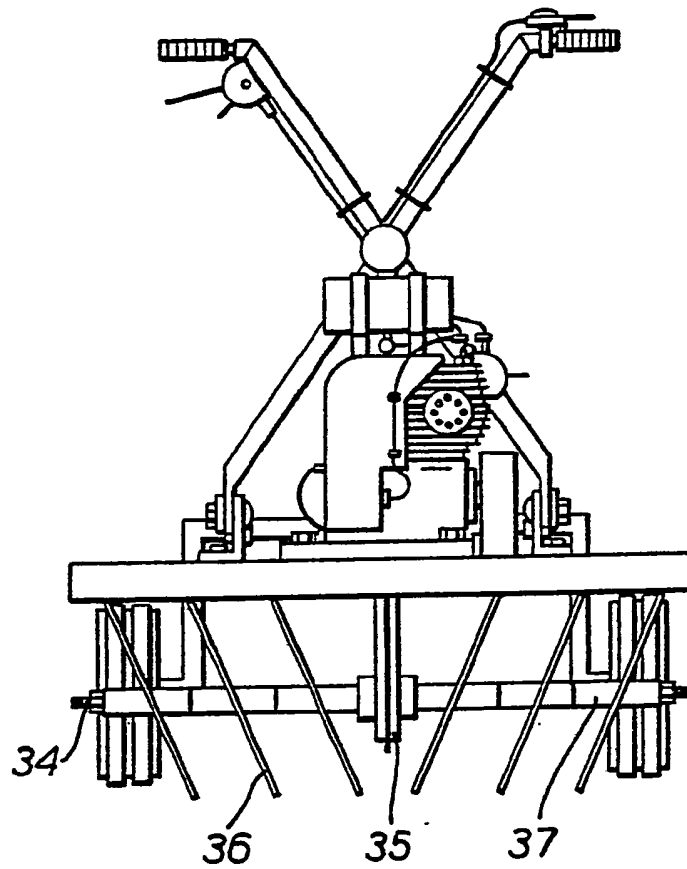


Fig. 23.

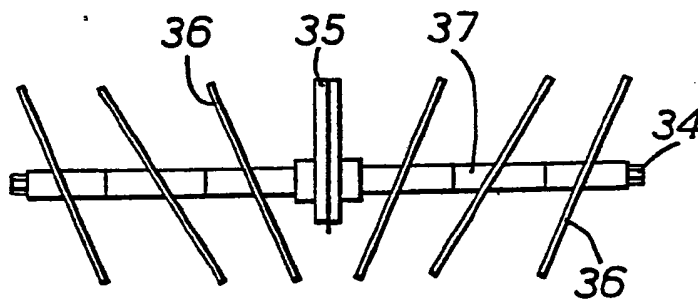


Fig. 24.

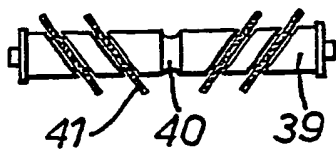


Fig. 26

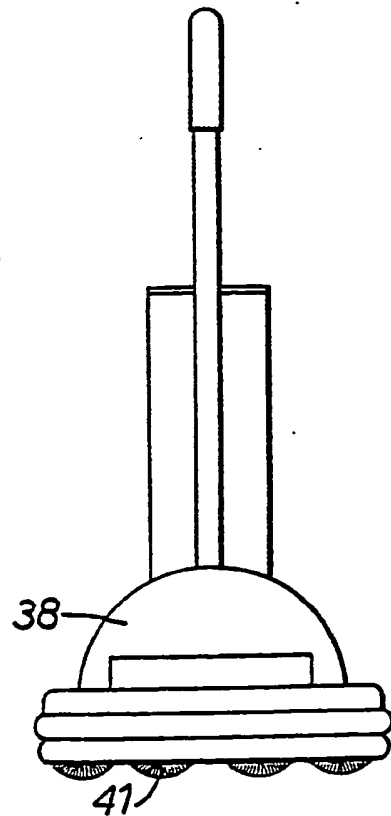


Fig. 25

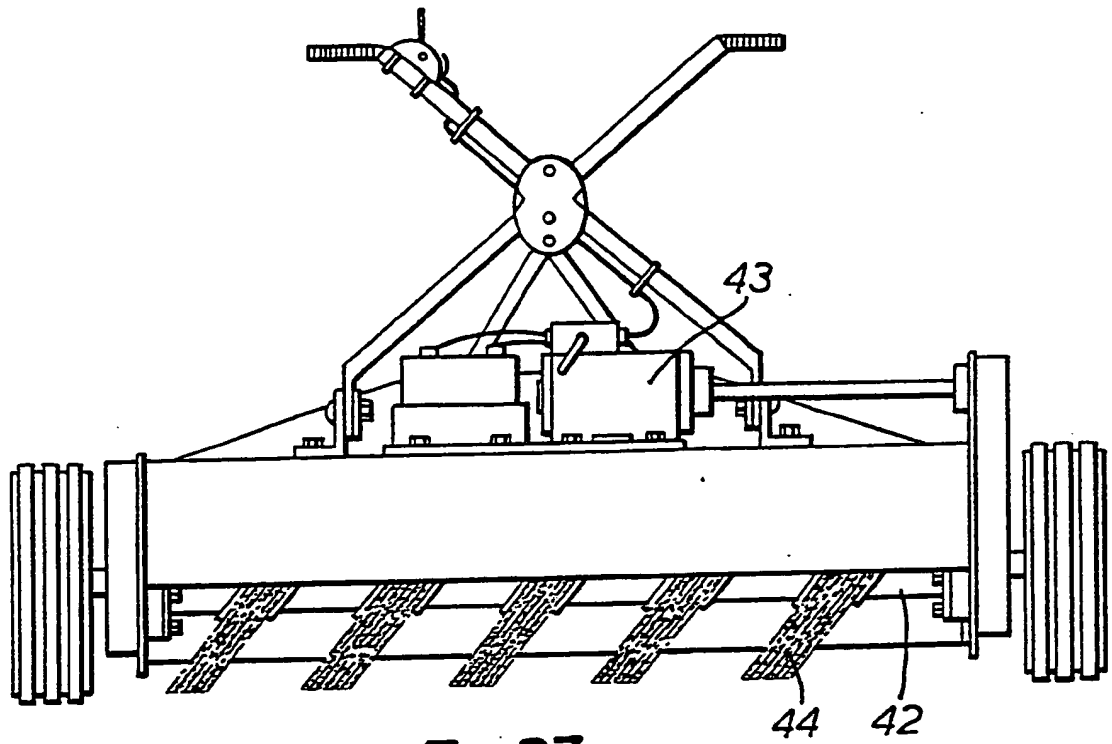


FIG. 27.

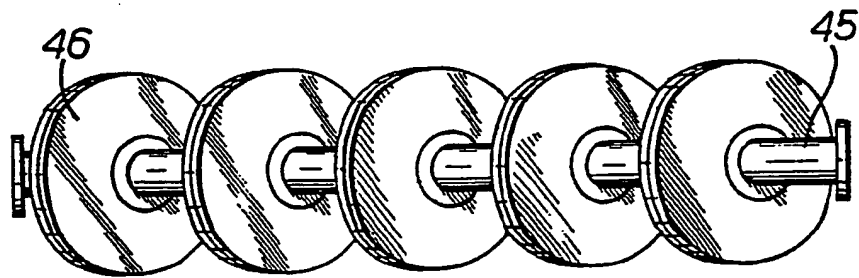


FIG. 28.

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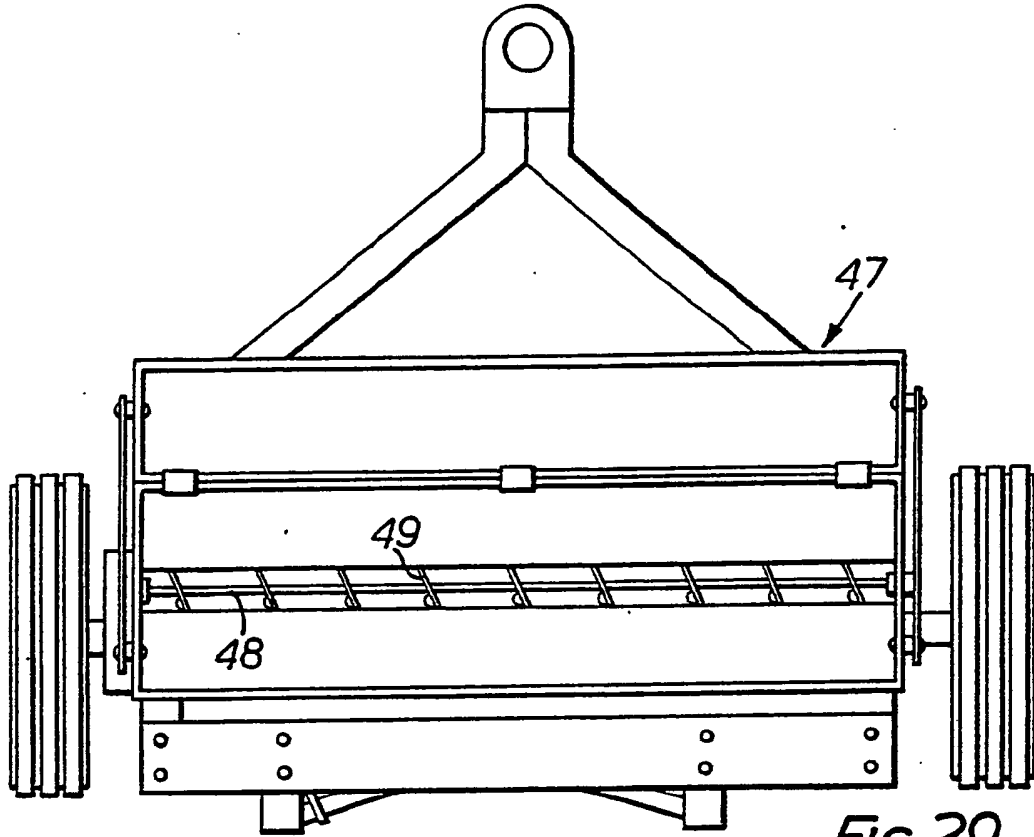
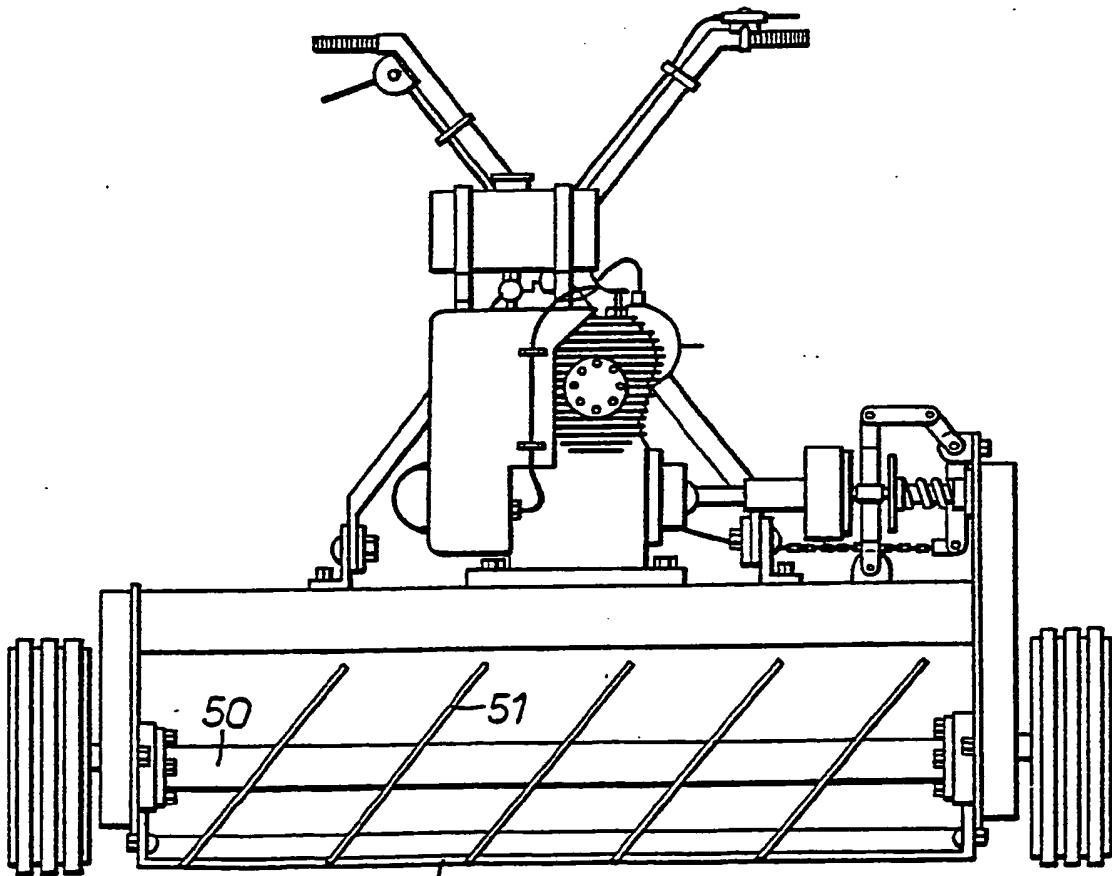
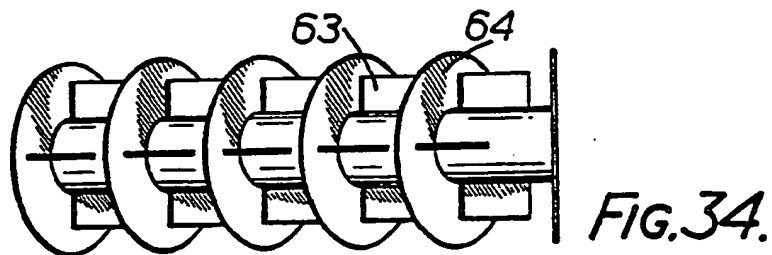
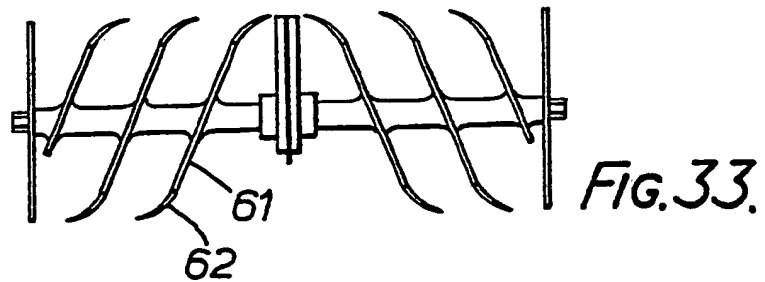
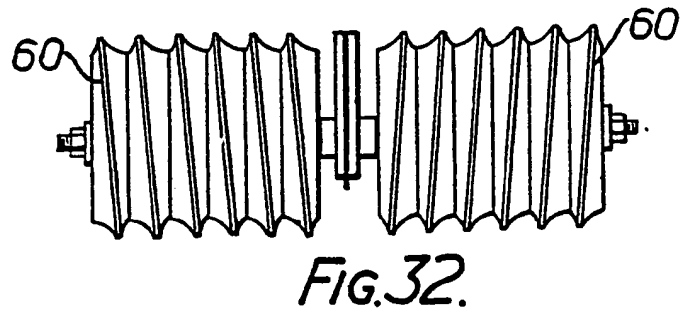
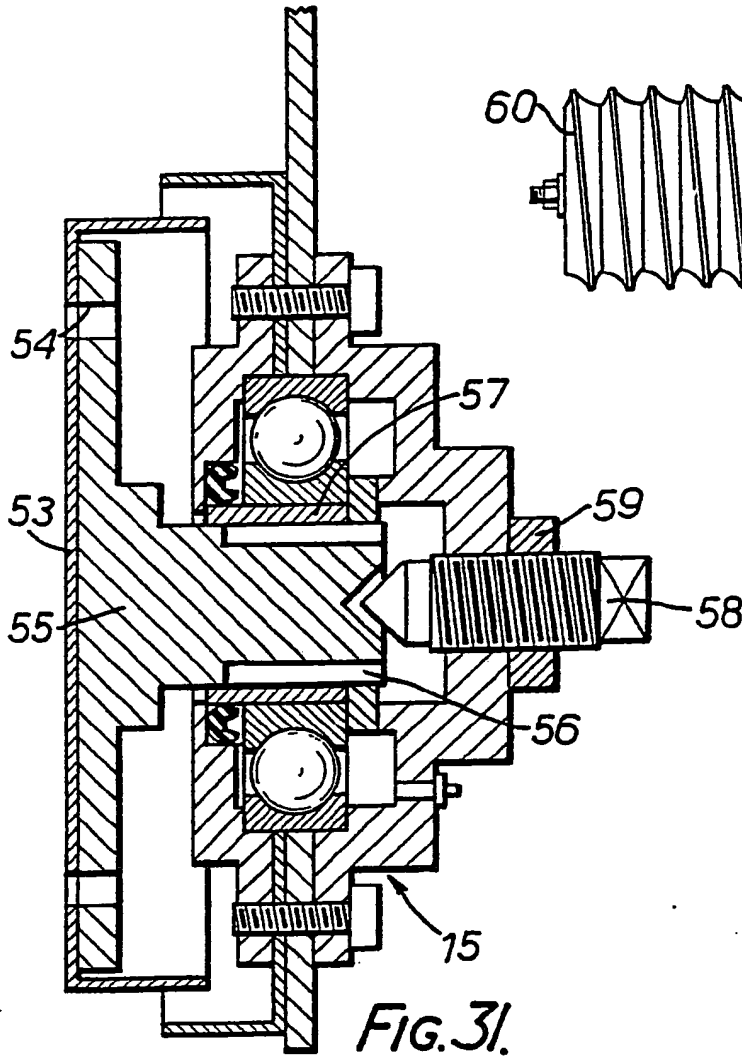


FIG. 29.





INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 83/00182

I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all) ³		
According to International Patent Classification (IPC) or to both National Classification and IPC ³ A 01 B 33/02; A 01 B 33/10; A 01 C 15/00; A 01 D 55/18; IPC: A 46 B 9/02; B 26 B 19/16; H 01 H 19/63; A 47 L 11/19		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁴		
Classification System	Classification Symbols	
IPC ³	A 01 B; A 01 C; A 01 D; A 46 B; B 26 B; H 01 H; A 47 L	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁵		
III. DOCUMENTS CONSIDERED TO BE RELEVANT ¹⁴		
Category ⁶	Citation of Document, ¹⁵ with indication, where appropriate, of the relevant passages ¹⁷	Relevant to Claim No. ¹⁸
X	FR, A, 2059777 (LEBEGUE) 4 June 1971, see the entire document	1,2,3,4,5, 8,9,11
X	FR, A, 1574457 (MASCHINENFABRIK SCHMOTZER GMBH) 11 July 1969, see page 6, lines 17-39; page 7, lines 43-45; page 8, line 1; figures 1,2,3,4	1,3,4,5,6, 8,9,11
X	GB, A, 2026447 (HESTAIR FARM EQUIPMENT LTD.) 6 February 1980, see page 2, lines 90-130; figures 1,3,4,5	1,2,4,5,8, 9,11
X	DE, A, 2003976 (DREYER) 5 August 1981, see page 6, first paragraph; figures 1,2c	1,2,4,5,8, 9,11
X	US, A, 2772533 (SHIBLEY) 4 December 1956, see column 2, lines 41-53; figures 1,2	1,2,4,5,8, 9,11
X	US, A, 2767543 (REAM) 23 October 1956, see column 2, lines 55-71; figures 1, 2,6	1,2,4,5,8, 9,11
<p>¹⁶ Special categories of cited documents: ¹⁶</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"Z" document member of the same patent family</p>		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search ¹	Date of Mailing of this International Search Report ²	
31st October 1983	29 NOV. 1983	
International Searching Authority ¹	Signature of Authorized Officer ²⁰	

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		
Category *	Citation of Document, ¹⁶ with indication, where appropriate, of the relevant passages ¹⁷	Relevant to Claim No ¹⁸
X	US, A, 2484071 (BRAVER) 11 October 1949, see the entire document	1,2,4,5,8,9, 11
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X	US, A, 2282238 (NEWTON) 5 May 1942, see page 2, left-hand column, lines 59- 75; right-hand column; lines 1-3; page 3, left-hand column, lines 60-75; right-hand column, lines 1-45; figures 1-14	1,2,3,4,5, 8,9,11
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X	US, A, 4267690 (PIKE) 19 May 1981, see column 3, lines 46-68; column 4, lines 1-68; column 5, lines 1-10; figures 1,2,3,4	1,3,4,5,6,7, 8,9,11,12
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X	US, A, 3154851 (ERIKSON) 3 November 1964, see column 2, lines 24-72; column 3, lines 1-15; figures 1,3,5,6	1,4,5,6,7,8, 9,11,12
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A	US, A, 2906832 (FOSTER) 29 September 1959 see the entire document	11

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON

INTERNATIONAL APPLICATION NO.

PCT/GB 83/00182 (SA 5545)

This Annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 21/11/83

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US-A- 2767543		None	
US-A- 2484071		None	
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US-A- 3050204		None	
FR-A- 2128133	20/10/72	None	

For more details about this annex :
see Official Journal of the European Patent Office, No. 12/82

US-A- 3094174

None

US-A- 2906832None

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